IN THE CLAIMS

1. **(currently amended)** A magnet assembly for use in magnetic resonance measurements, comprising:

four or more pairs of magnets arranged to surround a tubular volume of space and provide in at least a portion of the surrounded volume a substantially homogeneous magnetic field, the magnets of each pair being disposed diametrically opposite each other with respect to the surrounded volume with magnetization directions having substantially the same orientation, and adjacent magnets of the assembly being separated by gaps, thereby permitting magnetic flux between adjacent magnets to substantially extend into the surrounded volume, the placement and magnetic properties of the magnets being selected to produce:

a. a first magnetic field, substantially homogeneous, within an inner portion of the surrounded volume; and

b.a second magnetic field, substantially different from the first magnetic field, in the remainder of the surrounded volume.

2. **(original)** The magnet assembly of claim 1, wherein gaps between adjacent magnets of the assembly comprise material of low magnetic permeability.

3. **(original)** The magnet assembly of claim 1, further comprising:

a support structure that holds the magnets in position, with each magnet held at a distance from adjacent magnets in the magnet assembly, thereby creating the gaps between adjacent magnets.

4. **(original)** The magnet assembly of claim 1, wherein the gaps between adjacent magnets comprise air or vacuum.

5. **(original)** The magnet assembly of claim 1, wherein the pairs of magnets include:
   a. a first pair of magnets oriented with their magnetizations pointing in a direction N, wherein N is substantially perpendicular to the axis;
   b. a second pair of magnets oriented with their magnetizations pointing in a direction substantially opposite to N;
   c. a third pair of magnets oriented with their magnetizations pointing in a direction between 1° and 179° away from N; and
   d. a fourth pair of magnets oriented with their magnetizations pointing in a direction between 181° and 359° from N.

6. **(canceled)**

7. **(original)** The magnet assembly of claim 1, wherein the second magnetic field is generated by the extension into the surrounded volume of magnetic flux between adjacent magnets.

8. **(original)** The magnet assembly of claim [6] 1, wherein the second magnetic field is heterogeneous.

9. **(original)** The magnet assembly of claim [6] 1, wherein the inner portion of the surrounded volume has substantially cylindrical shape.

10. **(original)** The magnet assembly of claim 1, wherein the magnets in the magnet assembly

are characterized by dimensions, magnetic properties, and orientations selected to produce the second magnetic field substantially different from the homogeneous magnetic field.

11. **(original)** The magnet assembly of claim 1, wherein at least one of the magnets in the magnet assembly comprises an electromagnet, the assembly further comprising: a control circuit coupled to the electromagnet and configured to control the current provided to the electromagnet, and thereby to control the spatial profile of the first and second magnetic fields.

12. **(original)** The magnet assembly of claim 1, further comprising: at least one moveable tuning shim mounted within at least one of the gaps, wherein the tuning shim comprises ferromagnetic or diamagnetic or paramagnetic material, thereby permitting control over the spatial profile of the magnetic fields through motion of the tuning shim(s) within gaps between adjacent magnets.

13. **(original)** The magnet assembly of claim 1, wherein the magnets of the magnet assembly are equally spaced.

14. **(original)** The magnet assembly of claim 1, wherein each of the gaps between adjacent magnets subtend about 13°-17° angular spacing.

15. **(original)** The magnet assembly of claim 1, wherein the number of magnets in the magnet assembly totals 2(n+1), where n is an integer greater than 1.

16. **(original)** The magnet assembly of claim 1 further adapted to receive within the enclosed volume core material from drilled rock.

17. **(previously amended)** The magnet assembly of claim 16 further comprising equipment measuring magnetic resonance signals from the core material disposed within the surrounded volume of space.

18. **(canceled)**

Claims 19-41 (withdrawn)

42. **(canceled)**

43. **(currently amended)** A magnet assembly comprising: six or more pairs of magnets and, the magnets of each pair disposed opposite each other around an axis such that a region of space is surrounded by the magnets with the axis passing through the surrounded region; wherein the pairs of magnets include:
    a. a first pair of magnets oriented with their magnetizations pointing in a direction N, wherein N is substantially perpendicular to the axis;
    b. a second pair of magnets oriented with their magnetizations pointing in a direction substantially perpendicular to the axis and substantially opposite to N;
    c. a third pair of magnets oriented with their magnetizations pointing in a direction substantially perpendicular to the axis and between about 1° and 90° from N;
    d. a fourth pair of magnets oriented with their magnetizations pointing in a direction substantially perpendicular to the axis and between about 90° and 179° from N;
    e. a fifth pair of magnets oriented with their magnetizations pointing in a direction

substantially perpendicular to the axis and between about 181° and 270° from N; and

f. a sixth pair of magnets oriented with their magnetizations pointing in a direction substantially perpendicular to the axis and between about 270° and 359° from N;

g. wherein adjacent magnets are separated by gaps, thereby permitting magnetic flux between adjacent magnets to substantially extend into the surrounded region and the positions and magnetic properties of the magnets being selected to produce: (1) a first magnetic field, substantially homogeneous, within a first subregion of the surrounded region, and (2) a second magnetic field, substantially different from the first magnetic field, within a second subregion o fthe surrounded region, wherein the second subregion is located around the first region.

44. (original) The magnet assembly of claim 43, wherein the gaps comprise material of low magnetic permeability.

45. (previously amended) The magnet assembly of claim 43, further comprising: a support structure that holds the magnets in position, with each magnet held at a distance from adjacent magnets in the magnet assembly, thereby permitting magnetic flux between adjacent magnets to substantially extend into the surrounded region.

46. (canceled)

47. (original) The magnet assembly of claim 46, wherein the second magnetic field is heterogeneous.

48. (original) The magnet assembly of claim 46, wherein the first subregion has substantially cylindrical shape.

49. (original) The magnet assembly of claim 46, wherein the magnets in the magnet assembly are characterized by dimensions, magnetic properties, and orientations selected to produce the second magnetic field substantially different from the first magnetic field.

50. (previously amended) A magnet assembly comprising:

a. four or more magnets disposed around a tubular volume of space, the magnets being disposed so that their magnetization directions have substantially the same orientation, and adjacent magnets of the assembly being separated by gaps, thereby permitting magnetic flux between adjacent magnets to substantially extend into the surrounded volume; and

b. a ring made of high permeability material, the ring disposed around the magnets to provide a path for magnetic field lines of the magnets.

51. (original) The magnet assembly of claim 50, wherein the ring is made of ferromagnetic material.

52. (original) The magnet assembly of claim 50, wherein the ring comprises two or more elements, with gaps between the two or more elements.

53. (original) The magnet assembly of claim 50, wherein the ring is a continuous cylindrical element.

54. (original) The magnet assembly of claim 50, wherein gaps between adjacent magnets of the assembly comprise material of low magnetic permeability.

55. **(original)** The magnet assembly of claim 50, further comprising: a support structure that holds the magnets in position, with each magnet held at a distance from adjacent magnets in the magnet assembly, thereby creating the gaps between adjacent magnets.

56. **(original)** The magnet assembly of claim 50, wherein the gaps between adjacent magnets comprise air or vacuum.

57. **(original)** The magnet assembly of claim 50, the placement and magnetic properties of the magnets and the gaps therebetween being selected to produce:
    a. a first magnetic field, substantially homogeneous, within an inner portion of the surrounded volume, and
    b. a second magnetic field, substantially different from the first magnetic field, in the remainder of the surrounded volume.

58. **(original)** The magnet assembly of claim 57, wherein the second magnetic field is heterogeneous.

59. **(original)** The magnet assembly of claim 50, wherein the inner portion of the surrounded volume has substantially cylindrical shape.

60. **(original)** The magnet assembly of claim 50, wherein at least one of the magnets in the magnet assembly comprises an electromagnet, and the assembly further comprises a control circuit coupled to the electromagnet and configured to control the current provided to the electromagnet, and thereby to control the spatial profile of the first and second magnetic fields.

61. **(original)** The magnet assembly of claim 50, further comprising: at least one moveable tuning shim mounted within at least one of the gaps, wherein the tuning shim comprises ferromagnetic or diamagnetic or paramagnetic material, thereby permitting control over the spatial profile of the magnetic fields through motion of the tuning shim(s) within gaps between adjacent magnets.

62. **(original)** The magnet assembly of claim 50, wherein the number of magnets in the magnet assembly totals 2(n+1), where n is an integer greater than 1.

63. **(original)** The magnet assembly of claim 50 further adapted to receive within the enclosed volume core material from drilled rock.

64. **(previously amended)** The magnet assembly of claim 63 further comprising equipment measuring magnetic resonance signals from the core material disposed within the surrounded volume of space.